

CLAIMS

What I claim is:

1. A method for recovering oil from a pattern element of a subterranean formation, the formation having an upper boundary and a lower boundary, the pattern element having a lower completion interval for fluid injection and a higher vertically displaced completion interval for fluid injection and a completion interval for fluid production, comprising:
 - injecting a gas into the lower completion interval at a first selected gas injection rate for a selected time;
 - injecting water into the higher completion interval at a first selected water injection rate for a selected time;
 - decreasing water injection rate into the higher completion interval for fluid injection for a selected time, while maintaining a selected gas injection rate into the lower completion interval for fluid injection, so as to increase rate of gas flow upward in the formation and form a mixed flow zone in the formation between the lower completion interval and the upper boundary of the formation, then continuing water injection into the higher completion interval for fluid injection; and
 - recovering oil from the completion interval for fluid production.
2. The method of claim 1 wherein the lower completion interval is in proximity to the lower boundary of the formation.
3. The method of claim 1 wherein the higher completion interval is in proximity to the upper boundary of the formation.
4. The method of claim 1 further comprising the step of injecting water at a selected WAG ratio into the lower completion interval for a selected time.
5. The method of claim 1 further comprising the step of injecting gas at a selected WAG ratio into the higher completion interval.
6. The method of claim 5 wherein the WAG ratio is obtained by setting the second selected water injection rate at zero for a selected time.

7. The method of claim 1 further comprising adding a tracer to the gas or water before injection.
8. The method of claim 1 further comprising adding a surfactant to the gas or water before injection.
9. The method of claim 1 further comprising, after a selected time, forming vertically displaced completion intervals for fluid injection in place of the completion interval for production and reversing the direction of flow through the pattern element by injecting gas and water into the vertically displaced completion intervals for fluid injection and converting one of the completion intervals for injection into a completion interval for production.
10. The method of claim 1 wherein the gas is selected from gases consisting of natural gas, natural gas containing heavier hydrocarbons, nitrogen, carbon dioxide, flue gas and mixtures thereof.
11. The method of claim 10 wherein the gas is miscible with the oil.
12. The method of claim 1 wherein the lower completion interval and the upper completion interval are formed in vertically displaced horizontal wellbores through the formation.
13. The method of claim 1 wherein the lower completion interval and the upper completion interval are formed by perforated intervals in a vertical wellbore.
14. A method for recovering oil from a pattern element of a subterranean formation, the formation having an upper boundary and a lower boundary, the pattern element having a lower completion interval for fluid injection and a higher vertically displaced completion interval for fluid injection and a completion interval for fluid production, comprising:

using predicted rock and fluid properties in the pattern element, conducting computer simulations of flow of reservoir fluids and injected gas and water in the pattern element, the injected gas and water being injected at selected rates for selected times, the gas being injected into the lower completion interval for fluid injection and the water being injected into the higher vertically displaced completion interval for

fluid injection and fluid being produced from the completion interval for fluid production;

selecting the rate and times of gas injection and water injection based on the computer simulations to predict a WAG ratio to be injected into the upper completion interval so as to cause gas injected into the lower completion interval for fluid injection to flow to the upper boundary of the formation and the completion interval for fluid production at about the same time;

injecting gas and water at selected rates to cause the predicted WAG ratio; and recovering oil from the completion interval for fluid production.

15. The method of claim 14 further comprising adding a tracer to the gas before injection, measuring the amount of tracer in a fluid sample from the formation and selecting a revised rate and time of injection of water or gas based on the amount of tracer in the fluid sample.

16. The method of claim 14 further comprising adding a surfactant to the gas or water before injection.

17. The method of claim 14 wherein the gas is selected from gases consisting of natural gas, natural gas containing heavier hydrocarbons, nitrogen, carbon dioxide, flue gas and mixtures thereof.

18. The method of claim 17 wherein the gas is miscible with the oil.

19. The method of claim 14 wherein the lower completion interval and the upper completion interval are formed in vertically displaced horizontal wellbores through the formation.

20. The method of claim 14 wherein the lower completion interval and the upper completion interval are formed by perforated intervals in a vertical wellbore.